

# Improving Food Security Through Cooking and Food Literacy Among Students Enrolled in a Basic Food Science Lab at Appalachian State University

A Thesis  
By  
MAGGIE L. MORGAN

Submitted by the Graduate School  
at Appalachian State University  
in partial fulfillment of the requirements for the degree of  
MASTER OF SCIENCE

May 2020  
Department of Nutrition and Healthcare Management

Improving Food Security Through Cooking and Food Literacy Among Students Enrolled in a  
Basic Food Science Lab at Appalachian State University

A Thesis  
By  
MAGGIE L. MORGAN  
May 2020

APPROVED BY:

---

Jamie B. Griffin, Ph.D., RDN, LDN  
Chairperson, Thesis Committee

---

Alisha R. Farris, Ph.D., RDN  
Member, Thesis Committee

---

John Arrowood, MS, RDN, LDN  
Member, Thesis Committee

---

Margaret Barth, Ph.D., MPH  
Chairperson, Department of Nutrition & Health Care Management

---

Michael McKenzie, Ph.D.  
Dean, Cratis D. Williams School of Graduate Studies

Copyright by Maggie L. Morgan 2020  
All Rights Reserved

## **Abstract**

Improving Food Security Through Cooking and Food Literacy Among Students Enrolled in a  
Basic Food Science Lab at Appalachian State University

Maggie L. Morgan  
BS The Pennsylvania State University

Chairperson: Dr. Jamie Griffin

A dual relationship between food insecurity and inadequate food literacy exists among college students and may be attributed to limited food literacy, availability and ability to prepare healthful foods. College learning experiences that increase food literacy can improve diet quality and reduce food insecurity. Research was conducted to increase food literacy and combat food insecurity through a food literacy-based curriculum. Food literacy outcomes and food security level were measured pre- and post-term through a Qualtrics-based survey. Analyses included Wilcoxon Signed Rank test and McNemar test. Analysis was completed on participants who completed both the pre and post surveys (n=39). Over 30% of participants identified as food insecure. Results showed an increase in food literacy-based confidence ( $p<.05$ ) in meal planning and other measurements. Food security did not improve; however, a positive trend toward food secure habits was observed. Food literacy-based confidence improved, which increases the potential for engagement and adaptation of the specific behavior. Improvements observed may provide positive coping skills to reduce food insecurity in this population.

### **Acknowledgements**

I wish to show gratitude to my professor and mentor, Dr. Jamie Griffin, and my entire thesis committee for their tireless guidance and support. I would also like to pay special regards to my cohort, who have been by my side through this research and writing process. Further appreciation goes to the entire Nutrition and Health Care Management Department and those professors involved in Appalachian State University's MS/DI nutrition program for pushing me to be the best person and to produce my best work.

## Table of Contents

Abstract.....	iv
Acknowledgements.....	v
Foreword.....	vii
Chapter 1: Introduction.....	1
References.....	10
Chapter 2: Article.....	14
References.....	28
Chapter 3: Summary of Findings and Limitations.....	31
References.....	35
Appendices.....	
Appendix A: Project Timeline.....	36
Appendix B: Lab Objectives.....	37
Appendix C: Participant Demographics.....	43
Appendix D: Recruitment Script.....	45
Appendix E: Assessment Tool.....	46
Appendix F: USDA Abstract and Poster.....	62
Appendix G: FNCE Abstract and Poster.....	64
Appendix H: NCAND Abstract and Poster.....	66
Vita.....	68

## **Foreword**

Chapter 2 of this thesis will be submitted to the *Journal of American College Health*, a peer-reviews journal published by Taylor & Francis Group; it has been formatted according to the style guide for that journal.

## Chapter 1-Introduction

### Background

Over 30% of the United States population is overweight or obese, including those within the college age group.<sup>1</sup> College is a period of tremendous change for many individuals. Although some students enter college with the knowledge and skills to make healthful food choices, this is often not the case. This transitional period often includes an increase in snacking and eating foods that are prepared outside of the home. Combined with a decrease in energy expenditure, this caloric imbalance is heavily to blame for the obesity epidemic.<sup>1</sup>

Students have been noted to consume higher amounts of high-fat foods and lower amounts of fruit and vegetables.<sup>2</sup> On average, Americans do not meet fruit and vegetable recommendations, with only 5.8% of college students meeting the minimum requirement of around 5 servings per day.<sup>3</sup> Establishing good eating habits during this time is critical, because these behaviors often continue through adulthood and can be very difficult to change once established.<sup>4</sup> To prevent negative consequences, such as weight gain and less healthful food habits, student learning experiences in the classroom can help facilitate positive eating behaviors and food habits.

Food literacy, a skill lacking in college students, includes the ability to plan, manage, select, prepare, and eat food.<sup>5</sup> Research shows that college students believe courses should increase their life skills and prepare them to make food related decisions.<sup>5</sup> Courses that teach food literacy to college-aged populations have the potential to increase cooking literacy, healthful food consumption, food safety knowledge, and improve the home food environment.<sup>2</sup>

Another barrier to poor food habits and food literacy is food insecurity. Food insecurity refers to a lack of available financial resources for food at the level of the household,<sup>6</sup> and is



becoming a more widely recognized issue among students on college campuses. Food insecurity is a national and global issue that affects people of all races, genders, economic backgrounds, and so on. Various results have suggested the complications of food insecurity begin during freshman year of college.<sup>7</sup> This indication of a significant change is gaining attention within the field of nutrition. University characteristics, individual, social, and environmental determinants all play a part in the eating behaviors of students and should be considered equally in the development of food security interventions.<sup>8</sup> At Appalachian State University (App State), food insecurity was experienced by 28.6% of freshmen, with 42.5% of those claiming that their food access had worsened since starting college,<sup>7</sup> and current reports show food insecurity incidence on campus range from 46.2% to 62%.<sup>9,10</sup>

### **Appalachian State University Stats/Information**

Boone, North Carolina is the home of App State. The town of Boone is located in Watauga County, a rural area located in the Appalachian mountain region of northwest North Carolina. In 2010, the population was 17,122.<sup>11</sup> The town's population doubles when App State has their regular fall and spring classes in session.<sup>11</sup> During fall semester 2019, App State enrollment reached over 19,000 students (17,518 undergraduate students and 1,762 graduate students).<sup>12</sup> The number of international students on campus reached 160, and 17.4% was the underrepresented population.<sup>13</sup> This small portion of the population has grown 47% since 2014. Students were also found to be 58% female, with a total of 387 enrolled student veterans.<sup>13</sup>

## **Literature Review**

### *Food and Physical Activity Behaviors*

Lack of time and internal motivation are strong influences on the reduced physical activity levels observed among college students. Lack of social support and perception of intimidation also play a part in low activity levels.<sup>8</sup> Students reported these factors also influence food selection.<sup>14</sup> Lack of time to shop and cook is also a frequent barrier to eating well. In addition, students identify a lack of knowledge necessary to recognize a healthy diet, while also engaging in behaviors such as overeating due to stress.<sup>8</sup> Environmental factors, such as location and convenience, influence both physical activity level and food selection. Research supports addressing the characteristics that make up unhealthy physical activity patterns and eating behaviors to positively influence campus food security.<sup>15</sup> One study found that teaching goal setting had a positive influence on food choices and was a viable option to utilize within interventions.<sup>15</sup>

### *Food Literacy*

Food literacy skills represent the necessary abilities needed for the knowledge, planning, conceptualization, preparation, and perception of food.<sup>16</sup> Being food literate has the ability to improve a student's overall well-being.<sup>5</sup> While eating proper nutrients is important for physical health, cooking and eating in a communal setting are related to bonding and can often be seen as a social expression of love. Time spent eating with family and friends positively influences emotional health. Individuals personalize priorities when it comes to planning, selecting, preparing, and eating food,<sup>5</sup> choosing to focus on health, enjoyment, or accessibility. The increasing availability of convenience foods is one of the major shifts in the dietary patterns of

the United States and is leading to some negative consequences both physically and emotionally.<sup>17</sup>

Providing people with food literacy and nutrition advice has been found to be ineffective if they lack the basic skills for implementation.<sup>18</sup> A study by Unklesbay et al. (1998) found that a student's college major is positively associated with food literacy skills.<sup>18</sup> Students in food-related majors such as dietetics, food science, nutrition, and health programs have significantly higher attitudes and greater knowledge in relation to healthy eating than those in non food-related majors.<sup>19</sup> Findings also showed that there was a higher correlation between cooking skills confidence and food skills confidence.<sup>19</sup> Findings in another study found that individuals with more food preparation experience had higher food literacy-related skills.<sup>20</sup> Providing individuals with food literacy-based skills experiences can lead to increased self-efficacy, greater use of food-related skills, and improved diet quality.<sup>21</sup> Studies focused on college students, show that students are interested in and willing to participate in programs that teach skills needed to improve their food literacy skills and promote a positive relationship with food.<sup>22</sup>

### *Food Literacy and Food Security: What's the Link?*

A dual relationship between food security and food literacy exists, as shown by Begley and colleagues (2019).<sup>23</sup> Findings from their study highlighted that participant food literacy-related behaviors such as meal planning ( $p=0.0088$ ), making a list before food shopping ( $p=0.0014$ ), and cooking at home using healthy ingredients ( $p<0.001$ ) were all independently associated with food security status.<sup>23</sup> For example, participants who were food insecure were less likely to make shopping lists and plan meals ahead of time. From a nutritional standpoint, food insecure participants were also less likely to utilize the food label or to change recipes to make them healthier. These findings suggest that food insecure participants may respond

differently than food secure participants to food literacy-based programs. Understanding the factors that lead to food insecurity will improve the development of programs and interventions with the overarching aim of combating food security through improving food literacy. To make effective participant outcomes more likely, successful program design may benefit from formative screening of participants beforehand to ensure lessons are tailored and specific to individuals in the target group.

### *Food Security*

The United States Department of Agriculture (USDA) defines food insecurity as a lack of consistent access to enough food for an active, healthy life.<sup>24</sup> Individuals with high food security have no reported indications of food-access problems or limitations, and those with marginal food security have one or two reported indications. Those who fall under these classifications are at very little risk for reduced food access, or limitations or changes in usual diet or food intake. However, those who fall under low food security are identified by having reduced quality, variety or desirability of diet with little or no indication of reduced food intake. Very low food secure individuals are identified by having multiple indications of disrupted eating patterns and reduced food intake.<sup>24</sup>

Food insecurity is associated with poor diet quality and increased chronic disease risk, which is greater in lower-income populations.<sup>25</sup> A study by Seligman et al. (2020) showed lower diet quality for lower-income individuals when compared to those of higher income individuals.<sup>25</sup> Two measures of diet quality among American's are the Healthy Eating Index-2005 and the Alternate Healthy Eating Index- 2010.<sup>26</sup> Lower-income, food-insecure adults consistently report lower scores on the Healthy Eating Index-2005 and Alternate Healthy Eating Index-2010, regardless of other demographic variables.<sup>3</sup>

### *Food Security on College Campuses*

Current estimates show more than 50% of 2- and 4-year college students are affected by some form of food insecurity.<sup>1</sup> A study at Appalachian State University using random sampling, surveyed students about their food security levels, coping strategies surrounding food, and money expenditure on food. Of the 1,093 respondents, 21.9% experienced low food security and 24.3% experienced very low food security in the past 12 months.<sup>9</sup> A follow-up study by the same researchers focusing on college freshmen found that 28.6% of freshmen experienced food insecurity in their first year of school, suggesting that this issue is beginning early in academic careers.<sup>7</sup> Another study at App State revealed that 62% of students experienced some aspect of food insecurity.<sup>10</sup> While differing in findings, both studies found significant incidences of food insecurity among the student population setting a precedence for resources and research to determine effective ways to combat campus food insecurity.

College students identify food literacy as a life skill that universities should address to prepare them to make food-related decisions as well as help combat food insecurity on campus.<sup>5</sup> General education requirements that teach food and financial wellness, cooking lessons, food planning and preparation, budgeting and preparing nutritious meals to college-age populations may hold the potential to increase food literacy and promote food security.<sup>5,10</sup>

Building on this preface, the current study sought to develop a food literacy-based curriculum to increase food literacy skills and combat food insecurity among undergraduate students enrolled in the Basic Food Science Laboratory at Appalachian State University. In doing so, the researchers hoped to create an environment to promote the development of skills designed to decrease the prevalence of food insecurity and its related hardships.

## **Methodology**

### *Participants*

In Spring 2019, on the first day of classes, students (n=58) enrolled in a Basic Food Science Laboratory were recruited to participate in the current study. Students then received a standardized recruitment link to an online Qualtrics-based pre-assessment survey. Informed Consent was embedded within the online survey, and students who continued to the survey acknowledged and provided consent to participate. Of the students who agreed to participate and provided consent (n=55), most continued on to complete the presurvey (n=52). Students had the opportunity to earn up to 20 extra credit points (10 at pre-assessment; 10 at post-assessment) by completing the survey and providing a screenshot showing survey completion.

### *Intervention*

The lab curriculum targeted the home food environment, food literacy, and food security among the undergraduate population at Appalachian State University. The 11 labs were designed with goals and objectives revolving specifically around improving food literacy and food security. By the end of the semester, students would be able to: 1) demonstrate sanitizing lab stations and cooking space as well as making a sanitizing solution; 2) enhance their ability to eliminate food waste from purchased items; 3) cook each food item to its appropriate internal cooking temperature and demonstrate checking for doneness using a food thermometer; 4) prepare food within a limited budget; cost out recipes; and 5) develop and prepare a modified recipe from a conventional recipe. These experiential hands-on experiences provided students an opportunity to improve self-efficacy and confidence, both of which can lead to lifestyle and behavior change. The Appalachian State University Institutional Review Board approved this study.

### *Data Collection*

Pre- and post-assessment data were collected through an online anonymous Qualtrics-based survey to safeguard student identities. Students entered an identical 6 digit code at pre-assessment and post-assessment in order for researchers to pair pre-and post-assessment data to the same student. All participant information was kept confidential.

The survey tool was developed using adapted items from previously validated self-report instruments.<sup>15,16,18,19,21,27</sup> The survey used 3 scales: (1) ordinal data using a 5-point or 7-point Likert scale; (2) dichotomous data (yes/no); and (3) continuous data using open-ended questions. Identical questions were asked and pre- and post-assessment to determine changes in food literacy and food security among the observed population. At post-assessment, additional qualitative questions allowed students to provide program feedback. Students who completed both pre- and post-assessments received 20 extra credit points.

### *Statistical Analysis*

Descriptive statistics were used for demographic and physical characteristics. Data analyses included McNemar test (dichotomous data), Wilcoxon signed rank test (ordinal data), paired t-test (continuous data). Statistical significance was set at  $p < .05$ . Statistical analyses were performed using SPSS software (version 25, IBM Corp, Armonk, NY, 2015)

### *Research Purpose and Questions*

The purpose of the research was multi-faceted. It looked at using food literacy to combat indicators of food security through the development of food literacy-based skills. The work was to determine the effectiveness of participation in a Basic Food Science laboratory to promote healthful food purchasing and consumption habits, a healthy home food environment while also improving cooking literacy and food security in a college student population. Providing students

with a food literacy-based curriculum that incorporated both nutritional knowledge related to healthy eating and hands-on opportunities for applying basic cooking skills may improve health related knowledge, self-efficacy, attitudes, and food-related behaviors.<sup>1</sup>

Research Questions:

- 1) Does an Introduction to Basic Foods lab (NUT 1202 Lab) from pre- to post-semester positively improve food purchasing habits in college students?
- 2) Does an Introduction to Basic Foods lab (NUT 1202 Lab) from pre- to post-semester positively improve the home food environment in college students?
- 3) Does an Introduction to Basic Foods lab (NUT 1202 Lab) from pre- to post-semester positively improve food security by improving food literacy in college students?



## References

1. Broton K, Goldrick-Rab S. Going without: an exploration of food and housing insecurity among undergraduates. *Educ Res.* 2017. Accessed September 9, 2019.
2. Leung CW, Tester JM. The association between food insecurity and diet quality varies by race/ethnicity: an analysis of national health and nutrition examination survey 2011-2014 results. *J Acad Nutr Diet.* doi: 10.1016/j.jand.2018.10.011. Accessed October 12, 2019.
3. Leung CW, Epel ES, Ritchie LD, et al. Food insecurity is inversely associated with diet quality of lower-income adults. *J Acad Nutr Diet.* 2014;114(12):1943-53.e2. Accessed October 12, 2019.
4. Reed JA, Philips DA. Relationships between physical activity and the proximity of exercise facilities and home exercise equipment used by undergraduate university students. *J. Am. Coll. Health.* 2005;53(6):285-290. Accessed March 8, 2019.
5. Watson TD, Malan H, Glik D, Martinez SM. College students identify university support for basic needs and life skills as key ingredient in addressing food insecurity on campus: Food insecurity is a persistent stressor for some students; food literacy may help improve student well-being. *Calif Agric.* 2017; 71(13):130-138. Accessed September 8, 2018.
6. Food Insecurity. *Healthy People 2020.* <https://www.healthypeople.gov/2020/topics-objectives/topic/social-determinants-health/interventions-resources/food-insecurity>. Accessed January 13, 2020.
7. McArthur L, Fasczewski K, Wartinger E, Miller. Freshman at a university in Appalachia experience higher rate of campus than family food insecurity. *J Community Health.* 2018;43:969-976. January 12, 2019.

8. Mongiello L, Freudenberg N, Spark A. Making the healthy choice the easy choice on campus: a qualitative study. *Health Behav Policy Rev.* 2015;2(2):110--121. Accessed December 30, 2019.
9. McArthur L, Ball L, Danek A, Holbert. High prevalence of food insecurity among university students in Appalachia reflects a need for educational interventions and policy advocacy. *JNEB.* 2018;50:564-572. Accessed March 8, 2019.
10. Bortz J, Grubb M, Gentry C. Report on homelessness and food insecurity among Appalachian State University students during the 2017-2018 academic year. *Appalachian State University.*  
[https://history.appstate.edu/sites/history.appstate.edu/files/asu\\_profile\\_files/homelessnessandfoodinsecurity4\\_1\\_0.pdf](https://history.appstate.edu/sites/history.appstate.edu/files/asu_profile_files/homelessnessandfoodinsecurity4_1_0.pdf). Accessed February 20, 2019.
11. Boone, North Carolina. Wikipedia.  
[https://en.wikipedia.org/wiki/Boone,\\_North\\_Carolina](https://en.wikipedia.org/wiki/Boone,_North_Carolina). Accessed December 24, 2019.
12. About Appalachian State University. *Appalachian State University.*  
<https://www.appstate.edu/about/>. Accessed December 24, 2019.
13. Diversity and Inclusion at Appalachian State University. *Appalachian State University.*  
<https://diversity.appstate.edu/>. Accessed February 15, 2020.
14. Deliens T, Clarys P, De Bourdeaudhuij I, Deforche B. Determinants of eating behavior in university students: a qualitative study using focus group discussions. *BMC Public Health.* 2014;14(1):1-22. Accessed September 8, 2018.
15. O'Donnell S, Greene G, Blissmer B. the effect of goal setting on fruit and vegetable consumption and physical activity level in a web-based intervention. *J Nutr Educ Behav.* 2014;46(6):570-575. Accessed September 25, 2018.

16. Vrhovnik L. A pilot study for the development of a food skills survey tool. Queen's University. Kingston, Ontario, Canada. 2017. Retrieved from:  
[https://qspace.library.queensu.ca/bitstream/handle/1974/7323/Vrhovnik\\_Lydia\\_201207\\_MSc.pdf%20on%2010th%20May%202014;jsessionid=6899322DD78CE68B84D4A6B66B8F3590?sequence=3](https://qspace.library.queensu.ca/bitstream/handle/1974/7323/Vrhovnik_Lydia_201207_MSc.pdf%20on%2010th%20May%202014;jsessionid=6899322DD78CE68B84D4A6B66B8F3590?sequence=3). Accessed September 25, 2018.
17. Frans N. Development of cooking skills questionnaire for EFNEP participants in Kansas. Kansas State University. Manhattan, KS. 2017. Retrieved from: <http://krex.k-state.edu/dspace/bitstream/handle/2097/35449/NikeFrans2017.pdf?sequence=1>.  
 September 25, 2018.
18. Caraher M, Lang T. Can't cook, won't cook: A review of cooking skills and their relevance to health promotion. *Int J Health Promot Educ*. 1999;37(3). Accessed November 15, 2019.
19. Unklesbay N, Sneed J, Toma R. College students' attitudes, practices, and knowledge of food safety. *J. Food Prot*. Vol. 61, No.9, 1998, Pages 1175-1180. October 12, 2019.
20. Lavelle F, McGowan L, Hollywood L, et al. The development and validation of measures to assess cooking skills and food skills. *Int J Behav Nutr Phys Act*. 2017;14:118.  
 November 15, 2019.
21. McGowan L, Caraher M, Raats M, et al. Domestic cooking and food skills: A review. *Crit Rev Food Sci Nutr*. 2017;57(11):2412-243. Accessed November 16, 2019.
22. McMullen J, Ickes M, Nolan M, Erwin H, Helme D. Development of "College CHEF," a campus-based culinary nutrition program. *Am J Health Educ*. 2016;48(1):22-31.  
 Accessed December 30, 2019.

23. Begley A, Paynter E, Butcher L, Dhaliwal S. Examining the association between food literacy and food insecurity. *Nutrients*. 2019; 11:445. Doi:10.2290/nu11020445. January 12, 2019.
24. Definitions of Food Security. *United States Department of Agriculture*. <https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-us/definitions-of-food-security/>. Accessed January 13, 2020.
25. Seligman H, Laraia B, Kushel M. Food insecurity is associated with chronic disease among low-income NHANES participants. *J Nutr*. 2010; 140:304-310. doi:10.3945/jn.109.112573. January 13, 2020.
26. Healthy Eating Index (HEI). *Food and Nutrition Service - United States Department of Agriculture*. <https://www.fns.usda.gov/resource/healthy-eating-index-hei>. Accessed January 13, 2020.
27. Barton K, Wrieden W, Anderson A. Validity and reliability of a short questionnaire for assessing the impact of cooking skills interventions. *J Hum Nutr Diet*. 2011;24(6):588-595.

## **Chapter 2: Article**

IMPROVING FOOD SECURITY THROUGH COOKING AND FOOD LITERACY AMONG  
STUDENTS ENROLLED IN A BASIC FOOD SCIENCE LAB AT APPALACHIAN STATE  
UNIVERSITY

Author Contact Information:

Maggie L. Morgan, BS  
Corresponding Author, Reprint Contact  
MS Candidate  
Appalachian State University, Department of Nutrition & Health Care Management  
11016 Ballards Pond Ln  
Matthews, NC 28105  
(484) 797-4335  
[morganml4@appstate.edu](mailto:morganml4@appstate.edu)

John Arrowood, MS, RDN, LDN  
Lecturer in Nutrition  
Appalachian State University, Department of Nutrition & Health Care Management  
Leon Levine Hall of Health Sciences  
1179 State Farm Rd, ASU Box 32168  
Boone, NC 28607  
Phone: (828) 262-2084  
Fax: (828) 262-7482  
[arrowoodj@appstate.edu](mailto:arrowoodj@appstate.edu)

Alisha Farris, PhD, RDN  
Assistant Professor  
Appalachian State University, Department of Nutrition & Health Care Management  
Leon Levine Hall of Health Sciences  
1179 State Farm Rd, ASU Box 32168  
Boone, NC 28607  
Phone: (828) 262-7863  
Fax: (828) 262-7482  
[farrisar@appstate.edu](mailto:farrisar@appstate.edu)

Jamie B. Griffin, PhD, RDN, LDN  
Assistant Professor  
Appalachian State University, Department of Nutrition & Health Care Management  
Leon Levine Hall of Health Sciences  
1179 State Farm Rd, ASU Box 32168  
Boone, NC 28607  
Phone: (828) 262-8534  
Fax: (828) 262-7482  
[griffinjb@ppstate.edu](mailto:griffinjb@ppstate.edu)

**Abstract:**

A dual relationship between food insecurity and inadequate food literacy exists among college students and may be attributed to limited food literacy, availability and ability to prepare healthful foods. College learning experiences that increase food literacy can improve diet quality and reduce food insecurity.

Research was conducted to increase food literacy and combat food insecurity through a food literacy-based curriculum. Food literacy outcomes and food security level were measured pre- and post-term through a Qualtrics-based survey. Analyses included Wilcoxon Signed Rank test and McNemar test.

Analysis was completed on participants who completed both the pre and post surveys (n=39).

Over 30% of participants identified as food insecure. Results showed an increase in food literacy-based confidence ( $p < .05$ ) in meal planning and other measurements. Food security did not improve; however, a positive trend toward food secure habits was observed.

Food literacy-based confidence improved, which increases the potential for engagement and adaptation of the specific behavior. Improvements observed may provide positive coping skills to reduce food insecurity in this population.

*Keywords: food security; food literacy; students; college*

**Introductory note:** Maggie Morgan attended The Pennsylvania State University where she received a Bachelor of Science in Nutrition and Dietetics in 2018. Currently, she is scheduled to receive her Master of Science in Nutrition and Dietetics from Appalachian State University in May 2020.

**Acknowledgements:** I wish to show gratitude to my professor and mentor, Dr. Jamie Griffin, and my entire thesis committee for their tireless guidance and support. I would also like to pay special regards to my cohort, who have been by my side through this research and writing process. Further appreciation goes to the entire Nutrition and Health Care Management Department and those professors involved in Appalachian State University's MS/DI nutrition program for pushing me to be the best person and to produce my best work.



**Introduction:** College is a period of tremendous change for many individuals.<sup>1</sup> Some students enter college with the knowledge and skills to make healthful food choices, but many do not.<sup>2</sup> This transitional period often includes an increased risk for becoming food insecure,<sup>2</sup> defined as the lack of access to food. Food insecurity on college campuses is gaining state and national attention, with current incidence of food insecurity on college campuses ranging from 15%-59%.<sup>2-7</sup> Recent data in the Appalachian region mirrors this trend, ranging from 37%-62%.<sup>3-6</sup> Food security status is also tied to diet quality, with poorer diet quality associated with higher food insecurity.<sup>8,9</sup>

A dual relationship between food insecurity and inadequate food literacy exists. Food literacy includes the ability to plan, manage, select, prepare and eat food.<sup>2, 10</sup> This disparity between food security and food literacy in college students may be attributed to limited food literacy, availability and ability to prepare healthful foods. Food literacy is a skill set lacking in college students,<sup>2</sup> but has been shown to be a protective factor against food insecurity.<sup>2</sup> Therefore, promoting food literacy may be an appropriate strategy to help protect students from food insecurity.<sup>2</sup>

Studies which have evaluated college student perceptions and education needs around campus food insecurity have found that students believe coursework should increase their life skills and prepare them to make food related decisions, including food literacy.<sup>2</sup> In a qualitative study at UCLA, students identified a desire for general education requirements that teach about food and financial wellness, including cooking lessons, food planning and preparation, budgeting and preparing nutritious meals.<sup>2</sup> Courses that teach food literacy to college-aged populations have the potential to increase food literacy, healthful food consumption, food safety knowledge, and the home food environment.<sup>11</sup>

The purpose of this study was to develop and implement a food literacy-based curriculum to increase food literacy and combat food insecurity among undergraduate students enrolled in a Basic Food Science Laboratory course at a rural university located in the Appalachian region.

## **Methods**

### *Participants*

In Spring 2019, on the first day of class, students (n=58) enrolled in a Basic Food Science Laboratory were recruited using a standardized script to participate in the current study. Students then received an email with a link to the online Qualtrics-based pre-assessment survey. Students (n=52) who continued to the survey acknowledged and provided consent to participate. After completion of the survey, students had the opportunity to earn extra credit points by providing a screenshot of the final page of the survey tool. A total of 20 extra credit points were available (10 at pre-assessment; 10 at post-assessment).

### *Intervention*

An eleven week food literacy-based curriculum was developed for the Basic Food Science laboratory, with goals and objectives targeting the home food environment, improved food literacy, and increased food security among the undergraduate population at Appalachian State University. End of the semester objectives included: 1) demonstrate sanitizing lab stations and cooking space as well as making a sanitizing solution; 2) enhance ability to eliminate food waste from purchased items; 3) cook each food item to its appropriate internal cooking temperature and demonstrate checking for doneness using a food thermometer; 4) prepare food within a limited budget; cost out recipes; and 5) develop and prepare a modified recipe from a conventional recipe. These experiential hands-on experiences provided students an opportunity to improve

self-efficacy and confidence, both of which can lead to lifestyle and behavior change.<sup>11</sup> The Appalachian State University Institutional Review Board approved this study.

### *Data Collection*

Pre- and post-assessment data were collected through an online anonymous Qualtrics-based survey to safeguard student identities. Students entered an identical 6 digit code at pre-assessment and post-assessment in order for researchers to pair pre-and post-assessment data to the same student. All participant information was kept confidential.

Survey questions were developed using adapted items from previously validated self-report instruments.<sup>12-17</sup> The survey used 3 scales: (1) ordinal data using a 5-point or 7-point Likert scale; (2) dichotomous data (yes/no); and (3) continuous data using open-ended questions. Identical questions were asked and pre- and post-assessment to determine changes in food literacy and food security among the observed population. At post-assessment, additional qualitative questions allowed students to provide program feedback.

### *Food Security*

Four questions assessed student food security from pre- to post-assessment. Students were asked, 1.) “Do you follow the instructions for storage on packaged foods?” Responses were either *Yes* or *No*; 2.) “Do you ever worry that you do not have enough money to buy the foods you wish to buy?” Responses were either *Yes or No*; 3.) “In the past month, did you ever cut the size of your meals or skip meals because there wasn’t enough money for food?” Responses were either *Yes* or *No*; 4.) “In the past month, did you ever eat less than you felt you should because there wasn’t enough money for food?” Responses were either *Yes* or *No*.

### *Statistical Analysis*

Descriptive statistics were used for demographic and physical characteristics. Data analyses included McNemar test (dichotomous data), Wilcoxon signed rank test (ordinal data), paired t-test (continuous data). Statistical significance was set at  $p < .05$ . Statistical analyses were performed using SPSS software (version 25, IBM Corp, Armonk, NY, 2015).

### **Results**

A total of 52 students (91%) provided consent and completed the pre-assessment. At post, 39 students completed the post-assessment survey, which resulted in a 75% retention rate.

#### *Demographics*

Using pre-assessment demographics, students ( $n=52$ ) were 20.1 ( $\pm 3.6$ ) years; and predominantly female (57%); sophomore (46%) or junior (25%) academic standing; nutrition and dietetics (44%) or fermentation science (30.8%) major; and lived off campus (65%). Using pre-assessment data, student demographics did not differ from pre-assessment, except that students ( $n=39$ ) who completed the study were older ( $21.2 \pm 3.6$ ) years.

#### *Food literacy-based behaviors, food literacy-based self-efficacy, and food security indicators*

Table 1 displays the pre- and post-assessment means and SD for the variables used to assess food literacy-based behaviors, food literacy-based self-efficacy, and food security indicators. Students exhibited significant improvement ( $p < .05$ ) from pre- to post-assessment for the following: 1) food literacy-based behaviors: preparing and cooking a meal with raw ingredients, proper food storage, and 2) food literacy-based self-efficacy: using different cooking methods; cooking with raw or basic ingredients; preparing a well-balanced meal; use substitutions in recipes; and, meal

planning. Food security indicators did not significantly improve from pre- to post-assessment (Table 1).

### *Influences on food purchases and food preparation*

Students were asked the biggest influences on how they 1) purchase foods and 2) prepare foods. At pre-assessment, students listed money, availability of food items, and health as the top three influences on food purchases. At post-assessment, students listed money, health, and senses (taste, smell, presentation, and texture) as the top three influences on food purchases. At pre-assessment, students listed senses (taste, smell, presentation, texture), health, and money as the top three influences on food preparation. At post-assessment, students listed senses (taste, smell, presentation, texture), money and health as the top three influences on food preparation.

At pre-assessment, students were asked which skills they were most interested in learning in the lab. Responses included *healthier cooking options*, *substituting ingredients* and *shopping for healthy food on a budget*. At post-assessment, 97.4% of students responded they learned these skills in lab.

### *Qualitative Results*

One student shared the following: “I truly benefited a lot from this class. I realized that there were a lot of things that I wasn’t doing correctly. I find myself using a lot of the skills that we were taught in lab and I feel a lot more confident about my ability to cook and prepare meals.” Significant changes in self-efficacy were observed. It is important to note some self-efficacy scores were already high at pre-assessment. This could be contributed to the high number of students who were nutrition and dietetic<sup>15</sup> or fermentation science majors, both of which require higher food literacy skills for program success. One student commented: “I feel confident about trying new foods and learning new cooking skills.”

## Comments

According to the present study, the prevalence of food insecurity at a rural, Appalachian university mirrors that of other public universities.<sup>18</sup> In this study we examined changes in food literacy-based self-efficacy and behaviors, and food security status after implementation of an 11-week food literacy-based curriculum.

This study supports previous research incorporating evidence-based nutrition knowledge with hand-on opportunities for applying basic cooking skills may improve behaviors, self-efficacy, and knowledge.<sup>19</sup> Students in this study significantly improved specific cooking skills such as 1) food literacy-based behaviors: preparing and cooking a meal with raw ingredients, proper food storage, and 2) food literacy-based self-efficacy: using different cooking methods; cooking with raw or basic ingredients; preparing a well-balanced meal; use substitutions in recipes; and, meal planning. Food security indicators did not significantly improve from pre- to post-assessment (Table 1).

**Table 1: Survey Results**

<b>Food Literacy</b>	<b>Pre <math>\bar{x}</math>(SD)</b>	<b>Post <math>\bar{x}</math>(SD)</b>	<b>p-value</b>
How often do you prepare and cook a main meal using raw ingredients (for example, cooking soup using fresh vegetables, or cooking chili using raw meat and fresh vegetables)? <sup>a</sup>	3.21 (1.2)	2.74 (1.4)	<b>.039*</b>
How often do you plan your meals ahead? <sup>a</sup>	4.90 (1.8)	4.74 (1.8)	.827
How often do you make a grocery list? <sup>a</sup>	4.00 (1.6)	3.79 (1.7)	.234
	<b>Pre (%)</b>	<b>Post (%)</b>	<b>p-value</b>

Do you follow the instructions for storage on packaged foods? <sup>b</sup> [yes]	82%	95%	<b>.046*</b>
<b>Self-efficacy</b>	<b>Pre <math>\bar{x}</math>(SD)</b>	<b>Post <math>\bar{x}</math>(SD)</b>	<b>p-value</b>
How confident do you feel using methods like cooking, chopping, mixing and stirring? <sup>c</sup>	4.21 (.83)	4.51 (.60)	<b>.037*</b>
How confident do you feel about using different methods to cook foods such as boiling, stir-frying, steaming and grilling? <sup>c</sup>	3.90 (.88)	4.44 (.68)	<b>.001**</b>
How confident do you feel about being able to cook raw or basic ingredients? <sup>c</sup>	3.95 (.88)	4.38 (.59)	<b>.003**</b>
How confident do you feel in your ability to prepare a well-balanced meal? A well balanced meal provides half a plate of fruits and vegetables, a quarter plate of meat or meat alternative, and a quarter plate of grain products like pasta or rice. <sup>c</sup>	4.05 (.83)	4.36 (.58)	<b>.018*</b>
How confident do you feel in your ability to use substitutions in a recipe if you don't have a specific ingredient? <sup>c</sup>	3.46 (.97)	4.15 (.63)	<b>.000***</b>
How confident do you feel in your ability to handle, store, and prepare foods safely? <sup>c</sup>	4.23 (.54)	4.44 (.63)	.059
How confident do you feel in your ability to plan meals for the week? <sup>c</sup>	3.74 (.82)	4.15 (.84)	<b>.009**</b>
How confident do you feel about purchasing foods? <sup>c</sup>	4.18 (.64)	4.33 (.66)	.134
How confident do you feel in your ability to compare food prices to save money? <sup>c</sup>	4.15 (.78)	4.28 (.60)	.346
<b>Food Security Indicators<sup>b</sup></b>	<b>Pre (%)</b>	<b>Post (%)</b>	<b>p-value</b>
Do you ever worry that you do not have enough money to buy the foods you wish to buy? [yes]	79%	72%	.206
In the past month, did you ever cut the size of your meals or skip meals because there wasn't enough money for food? [yes]	33%	31%	.302
In the past month, did you ever eat less than you felt you should because there wasn't enough money for food? [yes]	33%	38%	.593

- Response Scale: 1 = Daily, 2 = 4-6 times a week, 3 = 2-3 times a week, 4 = Once a week, 5 = Never
- Response Scale [Yes or No]
- Response Scale: 1 = Not confident at all, 2 = Not confident, 3 = Neither not confident nor confident, 4 = Confident, 5 = Extremely confident

Significance was set at  $p < .05$  [\*  $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ ]

At the end of term, students were able to show off their cooking skills and self-efficacy in a “Recipe Cookoff” by creating a recipe of their choosing using spare ingredients left over from labs. This activity allows students to use the knowledge and skills they have culminated over the course of the semester.

Student coping strategies for food insecurity mirrored those of previous studies.<sup>1</sup> Although food insecurity measures did not improve from pre- to post-semester some trends were observed, including students reported lower worry about having enough money to buy foods and cutting the size of a meal due to worry over money from pre- to post-semester (79% versus 72%; 33% versus 31%, respectively).

Many campuses are addressing food insecurity through faculty, staff and student education as well as emergency food assistance programs.<sup>21</sup> Appalachian State University is addressing the high incidence of campus food insecurity in a few novel ways through 1) the food lab curriculum, 2) the App Free Store and Food Pantry, 3) a new course offering “Food Security Skills”, and 4) a community partnership with Hunger and Health Coalition of Watauga County.

### ***Limitations***

Limitations to consider and possibly address in future studies include: 1) the short study length, 2) generalization to other universities cannot be concluded, and 3) the low number of behavior-focused survey questions. Thirteen weeks is a short amount of time to make long-term changes in food security. This was a one-group, pre-post-survey design with students at one university. Future research should include a 6, 12, and 24 or 36 month follow up to determine if food security remains high or if it is reduced after graduation. Food insecurity status may differ after graduation and upon job attainment.<sup>19</sup> Long-term follow-up may determine “lasting” delayed



effect of a food literacy-based curriculum on food security status. Many of the students had high self-efficacy at pre, which could possibly be explained by the high proportion of nutrition and dietetics majors and could have an effect on the results. Another possibility is that students overestimated their abilities at pre because they did not realize how difficult a task actually is.<sup>22</sup> The overall competence of students improved, but the study would benefit from the addition of more behavior-focused questions to the survey.

## **Conclusions**

This study adds to the literature that supports campus initiatives to improve food literacy skills to combat food insecurity. The food literacy skills students learned may ultimately translate into improved food security. Student feedback at post-semester was positive. Student improvement in attitude toward working with food in the home environment was observed. Although positive food security trends were observed, overall findings of this study were not statistically significant. Studies suggest food literacy may lead to improved food security in a college student population.<sup>3-5</sup> However, the present study did not find improvements with food security though food literacy confidence and skills improved. Food literacy improvements observed may provide positive coping skills to help reduce food insecurity in this target student population.

Implementing a food literacy-based curriculum into general education or wellness education requirements may have a positive effect on food security leading to increased physical and mental health and academic outcomes.<sup>3,4, 23</sup>

## **Funding**

No funding was used to support this research and/or the preparation of the manuscript.

**Conflict of interest disclosure**

The authors have no conflicts of interest to report. The authors confirm that the research presented in this article met ethical guidelines, including adherence to the legal requirements, of the United States and received approval from the Appalachian State University Institutional Review Board.

**Declaration of interest statement:** The authors declare that there is no conflict of interest.

## References:

1. Broton K, Goldrick-Rab S. Going Without: An Exploration of Food and Housing Insecurity Among Undergraduates. *Educational Researcher*. 2017. Accessed September 9,2019.
2. Watson TD, Malan H, Glik D, Martinez SM. College students identify university support for basic needs and life skills as key ingredient in addressing food insecurity on campus: Food insecurity is a persistent stressor for some students; food literacy may help improve student well-being. *Calif Agric*. 2017; 71(13):130-138. Accessed September 8, 2018.
3. McArthur L, Fasczewski K, Wartinger E, Miller. Freshman at a University in Appalachia Experience Higher Rate of Campus than Family Food Insecurity. *J Community Health*. 2018;43:969-976. January 12, 2019.
4. McArthur L, Ball L, Danek A, Holbert. High prevalence of Food Insecurity Among University Students in Appalachia Reflects a Need for Educational Interventions and Policy Advocacy. *JNEB*. 2018;50:564-572. Accessed March 8, 2019.
5. Bortz J, Grubb M, Gentry C. Report on Homelessness and Food Insecurity Among Appalachian State University Students During the 2017-2018 Academic Year. Appalachian State University.
6. Hagedorn R, Olfert M. Food Insecurity and Behavioral Characteristics for Academic Success in Young Adults Attending an Appalachian State University. *Nutrients*. 2018;10,361.
7. Castellanos D, Holcomb J. Food insecurity, financial priority, and nutrition literacy of university students at a mid-size private university. *Journal of American College Health*. 2018;68(1):16-20.

8. Leung CW, Tester JM. The Association between Food Insecurity and Diet Quality Varies by Race/Ethnicity: An Analysis of National Health and Nutrition Examination Survey 2011-2014 Results. *Journal of the Academy of Nutrition and Dietetics*. doi: 10.1016/j.jand.2018.10.011
9. Leung CW, Epel ES, Ritchie LD, et al. Food insecurity is inversely associated with diet quality of lower-income adults. *Journal of the Academy of Nutrition and Dietetics*. 2014;114(12):1943-53.e2.
10. Vidgen H, Gallegos D. Defining food literacy and its components. *Appetite*. 2014;76(1): 50-59.
11. Deliens T, Clarys P, De Bourdeaudhuij I, Deforche B. Determinants of eating behavior in university students: a qualitative study using focus group discussions. *BMC Public Health*. 2014;14(1):1-22. Accessed September 8, 2018.
12. O'Donnell S, Greene G, Blissmer B. The Effect of Goal Setting on Fruit and Vegetable Consumption and Physical Activity Level in a Web-based Intervention. *J Nutr Educ Behav*. 2014;46(6):570-575. Accessed September 25, 2018.
13. Vrhovnik L. A pilot study for the development of a food skills survey tool. Queen's University. Kingston, Ontario, Canada. 2017. Retrieved from: [https://qspace.library.queensu.ca/bitstream/handle/1974/7323/Vrhovnik\\_Lydia\\_201207\\_MSc.pdf%20on%2010th%20May%202014;jsessionid=6899322DD78CE68B84D4A6B66B8F3590?sequence=3](https://qspace.library.queensu.ca/bitstream/handle/1974/7323/Vrhovnik_Lydia_201207_MSc.pdf%20on%2010th%20May%202014;jsessionid=6899322DD78CE68B84D4A6B66B8F3590?sequence=3). Accessed September 25, 2018.
14. Caraher M, Lang T. Can't cook, won't cook: A review of cooking skills and their relevance to health promotion. *International Journal of Health Promotion and Education*. 1999;37(3). Accessed November 15, 2019.

15. Unklesbay N, Sneed J, Toma R. College Students' Attitudes, Practices, and Knowledge of Food Safety. *Journal of Food Protection*, Vol. 61, No.9, 1998, Pages 1175-1180. October 12, 2019.
16. McGowan L, Caraher M, Raats M, et al. Domestic cooking and food skills: A review. *Crit Rev Food Sci Nutr*. 2017;57(11):2412-243. Accessed November 16, 2019.
17. Barton K, Wrieden W, Anderson A. Validity and reliability of a short questionnaire for assessing the impact of cooking skills interventions. *Journal of Human Nutrition and Dietetics*. 2011;24(6):588-595.
18. Zein A, et al. Prevalence and correlates of food insecurity among U.S. college students: a multi-institutional study. *BMC Public Health*. 2019;660(19).
19. McMullen J, Ickes M. The Influence of a Campus-based culinary, Nutrition Education Program, “College CHEF,” on College Students’ Self-efficacy with Cooking Skills and Nutrition Behaviors. *Building Healthy Academic Communities Journal*. 2017;1(2):62-76.
20. Sogari G, Velez-Argumedo C, Gomez M, Mora C. College Students and Eating Habits: A Study Using an Ecological Model for Healthy Behavior. *Nutrients*. 2018;10(12):1823.
21. Goldrick-Rab S, Cady C, Coca V. Campus Food Pantries: Insights From a National Survey. *The Hope Center*. 2018.
22. Artino A. Academic self-efficacy: from educational theory to instructional practice. *Perspect Med. Educ*. 2012; 1(2): 76-85.
23. Patton-Lopez M, Lopez-Cevallos D, Cancel-Tirado D, Vazquez L. Prevalence and correlates of food insecurity among students attending midsize rural university in Oregon. *J Nutr Educ Behav*. 2014;46(3):209-14.

## Chapter 3: Summary of Findings/Limitations

### Results

A total of 55 students (95%) provided consent and 52 (91%) completed the pre-assessment. At post, 39 students completed the post-assessment (75% retention). Using pre-assessment demographics, students (n=52) were 20.1 ( $\pm 3.6$ ) years; and predominantly female (57%); sophomore (46%) or junior (25%) academic standing; nutrition and dietetics (44%) or fermentation science (30.8%) major; and lived off campus (65%). At post-intervention, using pre-assessment data, student demographics did not differ from pre-assessment, except that students (n=39) who completed the study were older ( $21.2 \pm 3.6$ ) years.

The prevalence of food insecurity at Appalachian State University mirrors that of other public universities. Students exhibited significant improvement ( $p < .05$ ) from pre- to post-assessment for the following: 1) food literacy-based behaviors: preparing and cooking a meal with raw ingredients, proper food storage, and 2) food literacy-based self-efficacy: using different cooking methods; cooking with raw or basic ingredients; preparing a well-balanced meal; use substitutions in recipes; and, meal planning (Appendix A). Food security indicators did not significantly improve from pre- to post-assessment.

Student responses showed an improvement in attitude toward working with food in the home environment. Students were asked, “How do you feel overall about this lab?” Responses included: “I truly benefited a lot from this class. I realized that there were a lot of things that I wasn’t doing correctly. I find myself using a lot of the skills that we were taught in lab and I feel a lot more confident about my ability to cook and prepare meals.”, and “I feel confident about trying new foods and learning new cooking skills.” At pre-assessment, students identified the following skills as most interested in learning during the lab: *healthier cooking options*,

*substituting ingredients, and shopping for health food on a budget.* After the study, over 97% of students responded they learned these skills during the semester.

### *Research Purpose and Questions*

The purpose of the research was multi-faceted. It looked at using food literacy to combat indicators of food security through the development of food literacy-based skills. The work was to determine the effectiveness of participation in a Basic Food Science laboratory to promote healthful food purchasing and consumption habits, a healthy home food environment while also improving cooking literacy and food security in a college student population. Providing students with a food literacy-based curriculum that incorporated both nutritional knowledge related to healthy eating and hands-on opportunities for applying basic cooking skills may improve health related knowledge, self-efficacy, attitudes, and food-related behaviors.<sup>1</sup>

### Research Questions:

- 1) Does an Introduction to Basic Foods lab (NUT 1202 Lab) positively improve food purchasing habits in college students from pre- to post-semester?

*Confidence in students' ability to plan meals for the week showed significant improvement ( $p=.009$ ). Although not significant, student confidence in purchasing foods ( $p=.134$ ) and comparing food prices to save money ( $p=.346$ ) showed a positive trend toward improvement from pre to post.*

- 2) Does an Introduction to Basic Foods lab (NUT 1202 Lab) positively improve the home food environment in college students from pre- to post-semester?

*A significant increase was seen in the frequency at which students prepared and cooked a main meal using raw ingredients ( $p=.039$ ), as well as in the number of participants who followed the instructions for storage on packaged foods  $p=(.046)$ . Self-efficacy also improved significantly in skills like cooking, chopping, mixing and stirring ( $p=.037$ ); using different methods to cook such as boiling, stir-frying, steaming and grilling ( $p=.001$ ); cooking with raw or basic ingredients ( $p=.003$ ); preparing a well-balanced meal ( $p=.018$ ); and ability to use substitution in a recipe ( $p=.000$ ).*

- 3) Does an Introduction to Basic Foods lab (NUT 1202 Lab) positively improve food security by improving food literacy in college students from pre- to post-semester?

*Findings were not significant, but results showed a trend toward improvement in food security indicators. Those who worried that they did not have enough money to buy the foods they wished to buy dropped from 79% to 72% ( $p=.206$ ), and skipping meals due to a lack of money for food dropped from 33% to 31% ( $p=.302$ ).*

### ***Limitations***

Several study limitations were identified. The short length of this study was the most notable limitation. One academic semester at Appalachian State University is 15 weeks long, which is just over three months. The Basic Food Science Lab is truncated even further, only meeting for 12 weeks. This means that the length of time available to conduct this study was even shorter than the length of a complete semester. Three months is a short amount of time to determine changes in food security status in this population. Another study limitation is that only students at one university, enrolled in one course completed the pre- and post-assessment survey; therefore, results cannot be generalized to all college students.



A final limitation of this study was the high self-efficacy/competence of the participants at pre-assessment. Scores were high in 6 out of 9 self-efficacy based questions. Students came from a variety of backgrounds including nutrition and fermentation science as well as a few other health-focused majors. These individuals may have already been exposed to food literacy-based concepts in previous coursework which could positively impact their self-efficacy and subsequently the overall results of this project. Another possibility is that students overestimated their abilities at pre because they did not realize how difficult a task actually is.<sup>2</sup> Findings indicated that competence started high, which meant there wasn't much room for improvement.

## **Conclusions**

Overall, some food literacy-based behaviors and self-efficacy improved. Post-assessment feedback was positive. Despite positive responses, the findings of this study were not significant in terms of change in food security status. Future research should 1) continue to assess food security and food literacy status of Basic Food Science students at pre- and post-semester, and 2) deliver surveys at 6, 12, 24 or 36 month post-intervention to determine the retention and future use of the food literacy-based information acquired through the Basic Food Science lab as well as food security status through long-term follow-up. This study adds to the literature that supports campus initiatives to combat food insecurity through food literacy-based interventions. Implementing a food literacy-based curriculum into general education or wellness education requirements may have a positive effect on food security leading to increased physical and mental health and academic outcomes.<sup>3-5</sup>

## References:

1. Broton K, Goldrick-Rab S. Going without: an exploration of food and housing insecurity among undergraduates. *Educ Res*. 2017. Accessed September 9,2019.
2. Artino A. Academic self-efficacy: from educational theory to instructional practice. *Perspect Med. Educ*. 2012; 1(2): 76-85.
3. McArthur L, Fasczewski K, Wartinger E, Miller. Freshman at a university in appalachia experience higher rate of campus than family food insecurity. *J Community Health*. 2018;43:969-976. January 12, 2019.
4. McArthur L, Ball L, Danek A, Holbert. High prevalence of food insecurity among university students in Appalachia reflects a need for educational interventions and policy advocacy. *JNEB*. 2018;50:564-572. Accessed March 8, 2019.
5. Patton-Lopez M, Lopez-Cevallos D, Cancel-Tirado D, Vazquez L. Prevalence and correlates of food insecurity among students attending midsize rural university in Oregon. *J Nutr Educ Behav*. 2014;46(3):209-14.

## **Appendix A: Project Timeline**

August 2018-October 2018 - Planning and IRB Submission/Approval

November-December 2018 - Pilot Study

January 2019 - pre survey data collection

April 2019 - post survey data collection

May 2019-September 2019 - Data Analysis

October 2019-March 2020 - Conclusions and final development of thesis document

April 2020 - Thesis Defense and pursuit of manuscript publication

## Appendix B: Lab Objectives

Week	Lab	Objectives
1	Lab Procedures and Policies, Food Safety, and Handwashing	<ol style="list-style-type: none"> <li>1. To introduce students to lab policies and procedures.</li> <li>2. To familiarize students with kitchen/lab.</li> <li>3. To familiarize students to common cookware/utensils.</li> <li>4. To introduce students to food safety.</li> <li>5. To familiarize students to proper hand washing technique.</li> <li>6. Students will be able to identify the difference between cleaning and sanitizing.</li> <li>7. Students will be able to properly demonstrate sanitizing lab stations and cooking space, as well as making sanitizing solution.</li> </ol>
2	Weights and Measures, and Knife Skills	<ol style="list-style-type: none"> <li>1. Students will be able to describe the difference between weight and volume.</li> <li>2. Students will be able to differentiate between when they should weight an ingredient or use a specific volume of an ingredient to prepare a recipe.</li> <li>3. Students will be able to accurately use a dry measuring cup and a liquid measuring cup to practice measuring skills.</li> <li>4. Students will be able to accurately use a food scale to weigh ingredients.</li> <li>5. Students will enhance their ability to eliminate food waste from purchased items.</li> <li>6. Students will be able to demonstrate how to properly wash fruits and vegetables.</li> <li>7. Students will practice washing fruits and vegetables to reduce food contamination before preparing and consuming.</li> <li>8. Students will demonstrate properly holding and handling a knife.</li> <li>9. Students will practice basic knife skills such as cutting, dicing, slicing, chopping and mincing.</li> <li>10. Students will be able to follow and prepare a recipe using basic or raw ingredients.</li> <li>11. Students will learn food safety skills necessary to reduce the opportunity for cross-contamination in food preparation scenarios.</li> <li>12. Students will prepare and portion out easy on-the-go snacks for at home.</li> </ol>
3	Cooking Techniques and Research	<ol style="list-style-type: none"> <li>1. Student will gain experience reading and following a recipe to prepare a food.</li> </ol>

	Project	<ol style="list-style-type: none"> <li>2. Student will gain experience preparing foods using moist and dry heat cooking techniques.</li> <li>3. Student will gain experience in differentiating differences in taste, flavor, and texture of like products prepared using different cooking techniques or recipe ingredient modification.</li> <li>4. Students will practice using cooking terminology to describe foods prepared and tasted in lab.</li> <li>5. Students will practice using sensory evaluation vocabulary to analyze foods prepared and tasted in lab.</li> <li>6. Students will practice various food preparation methods for different recipes and types of foods.</li> </ol>
4	Sensory Evaluation and Ethnic Foods	<ol style="list-style-type: none"> <li>1. Students will learn how to properly set-up a duo-trio sensory test using the Sensory Lab.</li> <li>2. Students will participate in a duo-trio sensory test using the discrimination/difference testing method.</li> <li>3. Students will demonstrate their ability to follow a recipe to prepare selected cultural foods.</li> <li>4. Students will prepare and taste recipes that are non-traditional American foods which are representative of various cultures.</li> <li>5. Students will analyze and describe the taste, appearance, acceptance and sensory properties of the prepared cultural foods.</li> </ol>
5	Fats/Oils, Sweeteners, and Starches	<ol style="list-style-type: none"> <li>1. Students will describe the structural, textural and taste changes that occur with using different types of lipids (oil versus fat).</li> <li>2. Students will demonstrate their ability to follow a recipe to modify a conventional pie shell prepared using butter with a modified pie shell prepared using oil.</li> <li>3. Students will determine the effect on quality, tenderness, flakiness and sensory characteristics between a pastry prepared using a fat compared to a pastry prepared using oil.</li> <li>4. Students will demonstrate confidence in using oils for multiple recipes that increase purchasing efficiency, such as using coconut oil as a fat and oil.</li> <li>5. To observe the changes taking place during gelatinization of a starch mixture.</li> <li>6. To compare thickening ability of various starches.</li> <li>7. Students will understand which thickening agent to use for a specific texture outcome.</li> </ol>
6	Research Project Experiment	<ol style="list-style-type: none"> <li>1. Conduct a food science-based research experiment to determine physical and sensory property changes between a conventional recipe and a modified recipe.</li> </ol>

		<ol style="list-style-type: none"> <li>2. Observe the changes that occur when modifying one recipe component within a recipe compared to a conventional recipe.</li> <li>3. Compare and contrast the appearance, flavor and texture of a conventional recipe to one recipe modification.</li> </ol>
7	Poultry, Fish, Soy, and Meat	<ol style="list-style-type: none"> <li>1. Students will demonstrate their ability will follow a recipe to prepare boneless chicken breasts using the dry heat cooking method of baking.</li> <li>2. Students will demonstrate their ability to follow a recipe to prepare boneless chicken breasts using the moist heat cooking method of stewing.</li> <li>3. Students will compare and contrast the sensory differences (texture and appearance) and perceived eating quality between two methods of cooking boneless chicken breast.</li> <li>4. Students will properly cook boneless chicken breasts to its appropriate internal cooking temperature and demonstrate checking for doneness using a food thermometer.</li> <li>5. Students will gain experience preparing fish, a leaner form of protein.</li> <li>6. Students will identify ways to properly incorporate fish into the diet.</li> <li>7. Students will become more confident with the preparation of meals and dishes that include fish.</li> <li>8. Students will demonstrate their ability to follow a recipe to prepare salmon using the dry heat cooking method of baking.</li> <li>9. Students will properly cook salmon to its appropriate internal cooking temperature and demonstrate checking for doneness using a food thermometer.</li> <li>10. Students will compare and contrast the sensory differences and perceived eating quality between two leaner forms of protein: fish and soy (tofu).</li> <li>11. Students will gain experience preparing tofu, a lean plant-based protein meat alternative.</li> <li>12. Students will identify ways to properly incorporate plant-based meat alternatives into the diet.</li> <li>13. Students will demonstrate their ability to follow a recipe to prepare tofu using the dry heat cooking method of baking.</li> <li>14. Students will properly cook tofu to its appropriate internal cooking temperature of 165F and demonstrate checking for doneness using a food thermometer.</li> <li>15. Students will compare and contrast the sensory differences and perceived eating quality between two leaner forms of protein: fish and soy (tofu).</li> </ol>

		<ol style="list-style-type: none"> <li>16. Students will determine the effect of both enzymatic and mechanical methods of tenderizing connective tissue on tenderness in meat.</li> <li>17. Students will evaluate the relative tenderness of meats prepared using two different forms of tenderizing.</li> <li>18. Students will demonstrate their ability will follow a recipe to prepare meat using the dry heat cooking method of pan frying.</li> <li>19. Students will compare and contrast the sensory differences and perceived eating quality between two tenderization methods of meat.</li> <li>20. Students will properly cook meat to its appropriate internal cooking temperature and demonstrate checking for doneness using a food thermometer.</li> </ol>
8	Milk/Dairy, Egg, and Cheese	<ol style="list-style-type: none"> <li>1. Students will demonstrate their ability will follow a recipe to prepare vanilla pudding using 2% milk.</li> <li>2. Students will demonstrate their ability to follow a recipe to prepare vanilla pudding using coconut milk.</li> <li>3. Students will gain experience making products with milk and a non-dairy milk substitutes.</li> <li>4. Students will compare and contrast the appearance, flavor and texture between two puddings prepared using cow milk or a non-dairy milk alternative.</li> <li>5. Students will demonstrate their ability to follow a recipe to prepare eggs using a foam formation, meringue, and cook using the baking method.</li> <li>6. Students will demonstrate their ability to follow a recipe to use eggs to create a meringue.</li> <li>7. Students will gain experience making products with eggs and egg substitutes.</li> <li>8. Students will compare and contrast the sensory differences (texture and appearance) and perceived eating quality between two puddings prepared using cow milk or a non-dairy milk alternative.</li> <li>9. Students will demonstrate their ability to follow a recipe to prepare cheese using a quick cheese method of preparation.</li> <li>10. Students will demonstrate their ability to follow a recipe to prepare a plant-based cheese alternative.</li> <li>11. Students will gain experience making a quick cheese and a non-dairy cheese alternative.</li> <li>12. Students will compare and contrast the sensory differences and perceived eating quality between two cheeses: paneer “milk-based” cheese and vegan “plant-based” cheese.</li> <li>13. Students will gain experience making non-dairy cheese alternatives.</li> </ol>

		14. Students will gain experience using various acids to make quick cheeses.
9	Vegetables and Fruits	<ol style="list-style-type: none"> <li>1. Students will demonstrate their ability will follow a recipe to prepare a vegetable using the dry heat cooking method of baking or roasting.</li> <li>2. Students will demonstrate their ability to follow a recipe to prepare a vegetable using the moist heat cooking method of stewing.</li> <li>3. Students will compare and contrast the sensory differences and perceived eating quality of a vegetable prepared using two different methods of cooking.</li> <li>4. Students will compare and contrast two butternut squash soup recipes: one that has been prepared using raw or basic ingredients (conventional preparation) and one that has been prepared from a ready-to-eat package (convenience preparation). <ul style="list-style-type: none"> <li>○ Evaluation will include taste, flavor, cost per serving, preparation time.</li> </ul> </li> <li>5. To gain experience in making vegetable and fruit recipes.</li> </ol>
10	Baking	<ol style="list-style-type: none"> <li>1. Students will demonstrate their ability to follow a recipe to prepare a thick dough and cook using the dry heat method by baking mixed berry scones and pizza dough. (50)</li> <li>2. Students will demonstrate their ability to follow a recipe to prepare a gluten-free baked product.</li> <li>3. Students will demonstrate their ability to follow a recipe to prepare a conventional (gluten-containing) baked product.</li> <li>4. Students will differentiate the structural qualities between a gluten-containing and a gluten-free baked product.</li> <li>5. Students will understand the formation of gluten and gluten's importance in providing structural integrity to baked products.</li> <li>6. Students will be able to identify and list the changes in appearance and texture that occurs from over mixing and undermixing a batter.</li> <li>7. Students will compare and contrast the sensory characteristics and perceived eating quality between several baked products.</li> <li>8. To educate students on ways to prepare a typically restaurant associated meal at home</li> <li>9. To determine the effects of variations in the mixing time on the quality of muffins.</li> <li>10. Students will understand the difference between biological and chemical leavening.</li> <li>11. Students will demonstrate their ability to prepare an economical yeast dough that can be used at home.</li> </ol>



		12. Students will observe the effects of mixing time on the appearance, texture and quality of hotcakes.
11	Recipe Stand-Off	<ol style="list-style-type: none"><li>1. To plan and prepare nutritious meal for a family with busy schedule.</li><li>2. To prepare food within a limited budget.</li><li>3. To cost out recipes.</li></ol>

## Appendix C: Participant Demographics

		Completed Both Pre and Post	Completed Only PreSurvey
Age (years)		21.18 +/- 3.64	20.23 +/- 3.61
Gender			
	Male	14 (35.9%)	8 (61.5%)
	Female	25 (64.1%)	5 (38.5%)
Relationship Status			
	Married	2 (5.1%)	1 (7.7%)
	Single	37 (94.9%)	12 (92.3%)
Hispanic/Latino			
	No	34 (87.2%)	13 (100%)
	Yes	5 (12.8%)	0 (0%)
Housing			
	Single Dorm	1 (2.6%)	0 (0%)
	Dorm with Roommates	9 (23.1%)	7 (53.8%)
	Apartment with Roommates	27 (69.2%)	6 (46.2%)
	Commuter	2 (5.1%)	0 (0%)
Number of People You Cook For		1.44 +/- 0.72	1.15 +/- 0.38
Academic Standing			
	Freshman	5 (12.8%)	4 (30.7%)
	Sophomore	17 (43.6%)	7 (53.8%)
	Junior	11 (28.2%)	2 (15.4%)
	Senior	6 (15.4%)	0 (0%)
Major			
	Nutrition/Dietetics	18 (46.1%)	5 (38.5%)
	Fermentation Sciences	11 (28.2%)	5 (38.5%)
	Exercise Science	5 (12.8%)	2 (15.4%)
	Other	5 (12.8%)	1 (7.7%)
Employment			
	None	23 (60.0%)	6 (46.1%)

	Part-time	15 (38.5%)	7 (53.9%)
	Full-time	1 (2.6%)	0 (0%)
Income			
	< \$15,000/year	36 (92.3%)	12 (92.3%)
	\$15,001 to \$25,000/year	3 (7.7%)	1 (7.7%)
Free Pantry Awareness*			
	No	19 (48.7%)	7 (53.9%)
	Yes, but never utilized	19 (48.7%)	5 (38.5%)
	Yes, have utilized	1 (2.6%)	1 (7.7%)

\*Appalachian State has a resource known as the Food Pantry and Free Store located in one of their halls. Any students or Appalachian family members who have needs for food or goods are welcome to visit and utilize this resource.

## **Appendix D: Recruitment Script**

### **Recruitment Script**

#### **Sent via email**

Welcome to Basic Food Science! This semester all Basic Food Science laboratory sections are invited to be part of a research study looking at the positive effects a Basic Food Science laboratory has on students' cooking literacy, home food environment, food purchasing, and food consumption habits.

You are eligible to participate if:

- You are an Appalachian State University student
- You are currently enrolled in a NUT 1202 Basic Food Science course.
- You complete the full course.

The study will consist of an online pre-course survey and a post-course survey.

The pre-course survey will be available from 12:55 PM Saturday, January 12th to 12:55 PM on January 22nd. The survey can be accessed by clicking the following link: (Place link for survey once live)

Participants who volunteer to join the research study can earn up to 20 points extra credit.

Please contact Sakina Craine ([crainesf@appstate.edu](mailto:crainesf@appstate.edu)), Maggie Morgan ([morganml4@appstate.edu](mailto:morganml4@appstate.edu)), or Dr. Jamie Griffin ([griffinjb@appstate.edu](mailto:griffinjb@appstate.edu)) with any questions.

Principle Co-Investigator: Sakina Craine

Principle Co-Investigator: Maggie Morgan

Faculty Mentor: Jamie Griffin , Ph.D.

Department of Nutrition and Healthcare Management

Appalachian State University

Boone, North Carolina

## Appendix E: Assessment Tool

**Hello! You said it would be OK for us to email you and get your opinion and thoughts. Your answers are important. They will help determine if the Basic Foods Laboratory will be helpful to others who are trying to learn basic food preparation and cooking skills. Your honesty will help us improve the program. All your answers are completely confidential. This survey should take no longer than 15 minutes.**

**Remember, there are no right or wrong answers. Let's get started.**

### Section Header

1. I enjoy cooking.
  - ☐ Strongly disagree
  - ☐ Somewhat disagree
  - ☐ Neither disagree nor agree
  - ☐ Somewhat agree
  - ☐ Strongly agree
2. I get a lot of satisfaction from cooking meals.
  - ☐ Strongly disagree
  - ☐ Somewhat disagree
  - ☐ Neither disagree nor agree
  - ☐ Somewhat agree
  - ☐ Strongly agree
3. Eating a meal cooked at home is important to me.
  - ☐ Strongly disagree
  - ☐ Somewhat disagree
  - ☐ Neither disagree nor agree
  - ☐ Somewhat agree
  - ☐ Strongly agree
4. What is the biggest influence on how you prepare foods? (please select all that apply)
  - ☐ Senses (taste, smell, presentation, texture)
  - ☐ Money
  - ☐ Culture
  - ☐ Health
  - ☐ Availability of food items
  - ☐ Family
  - ☐ Media (example: television, magazine, books, etc.)

- ☐ Other (please specify)
  - ☐ I don't cook
- 5. How did you first learn to cook?
  - ☐ Family
  - ☐ Friends
  - ☐ Media (example: television, magazine, books, etc.)
  - ☐ School
  - ☐ Other (please specify) \_\_\_\_\_
  - ☐ I do not know how to cook
- 6. How would you describe your current cooking skills?
  - ☐ Convenience foods/ready-made meals
  - ☐ Ready-made ingredients to complete a meal (ex: ready-made sauce)
  - ☐ Prepare dishes from basic ingredients
  - ☐ I do not cook at all
  - ☐ Other (open ended block)
- 7. Convenience foods are pre-packed foods that are bought and prepared easily. For example: Kraft Dinner, frozen chicken fingers. In the past day, how often have you eaten convenience foods?
  - ☐ None
  - ☐ Less than 1 time
  - ☐ 1-2 times
  - ☐ 3-4 times
  - ☐ 5 times or more
- 8. How often do you prepare and cook a main meal using raw ingredients (for example, cooking soup using fresh vegetables, or cooking chili using raw meat and fresh vegetables)?
  - ☐ Daily
  - ☐ 4-6 times a week
  - ☐ 2-3 times a week
  - ☐ Once a week
  - ☐ Less than once a week
  - ☐ Never

9. How often do you do the following? Plan your meals ahead?
- ☐ Never
  - ☐ Less than once a month
  - ☐ Once a month
  - ☐ 2-3 times a month
  - ☐ Once a week
  - ☐ 2-3 times a week
  - ☐ Daily
10. What meal do you spend the most time preparing?
- ☐ Breakfast
  - ☐ Lunch
  - ☐ Dinner
  - ☐ I do not prepare meals
11. On average, how much time do you spend making that meal?
- ☐ Less than 15 minutes
  - ☐ 15-30 minutes
  - ☐ 31-60 minutes
  - ☐ More than an hour
  - ☐ I don't cook
12. How often do you do the following? Make a grocery list?
- ☐ Never
  - ☐ Less than once a month
  - ☐ Once a month
  - ☐ 2-3 times a month
  - ☐ Once a week
  - ☐ 2-3 times a week
  - ☐ Daily
13. Once you are in the grocery store, how much time are you willing to put towards purchasing food for the week /biweekly. This could be at a farmer's market, convenience store, superstore, grocery store, etc.?
- ☐ Less than 15 minutes
  - ☐ 15-30 minutes
  - ☐ 31-60 minutes
  - ☐ More than an hour
  - ☐ I don't cook

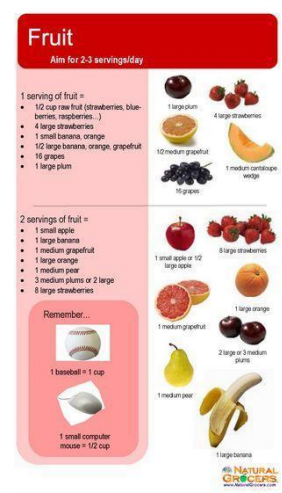
14. How many servings of vegetables do you usually eat each day?

- None
- 1 serving
- 2 servings
- 3 servings
- 4 servings
- 5 servings
- 6 or more servings



15. How many servings of fruit do you usually eat each day?

- None
- 1 serving
- 2 servings
- 3 servings
- 4 servings
- 5 servings
- 6 or more servings



16. How many servings of pasta and/or rice do you consume each day?

- None
- 1 serving
- 2 servings
- 3 servings
- 4 servings
- 5 servings
- 6 or more servings

17. How many servings of baked, boiled or mashed potatoes (not including chips or roast potatoes) do you consume each day?

- None
- 1 serving



- ☐ 2 servings
- ☐ 3 servings
- ☐ 4 servings
- ☐ 5 servings
- ☐ 6 or more servings

18. How many servings of chips, fried or roast potatoes do you eat each day?

- ☐ None
- ☐ 1 serving
- ☐ 2 servings
- ☐ 3 servings
- ☐ 4 servings
- ☐ 5 servings
- ☐ 6 or more servings

19. How many servings of fish or fish products, e.g. cod, tuna, or fish fingers, do you consume each day?

- ☐ None
- ☐ 1 serving
- ☐ 2 servings
- ☐ 3 servings
- ☐ 4 servings
- ☐ 5 servings
- ☐ 6 or more servings

20. How often do you eat fruits and vegetables as a snack?

- ☐ Never
- ☐ Less than once a month
- ☐ Once a month
- ☐ 2-3 times a month
- ☐ Once a week
- ☐ 2-3 times a week
- ☐ Daily

### **Section Header**

21. Do you wash fruits and vegetables that don't need to be peeled before eating them?

- ☐ No
- ☐ Yes
- ☐ Don't know

22. Do you eat food past its 'use by' date?

- ☐ No
- ☐ Yes
- ☐ Don't know

23. Do you follow the instructions for storage on packaged foods?

- ☐ No
- ☐ Yes
- ☐ Don't know

24. Do you check that food is piping hot when reheating?

- ☐ No
- ☐ Yes
- ☐ Don't know

25. How often are the following true? In my home, there are vegetables to have as a snack.

- ☐ Never
- ☐ Less than once a month
- ☐ Once a month
- ☐ 2-3 times a month
- ☐ Once a week
- ☐ 2-3 times a week
- ☐ Daily

26. How often do you do the following? Have fruits and vegetables ready to eat as a snack?

- ☐ Never
- ☐ Less than once a month
- ☐ Once a month
- ☐ 2-3 times a month
- ☐ Once a week
- ☐ 2-3 times a week
- ☐ Daily

27. Do you have some or all of the following basic food ingredients in your home? (pasta, rice, fresh, frozen or canned fruits and vegetables, meats and seasoning)

- ☐ No
- ☐ Yes
- ☐ Don't know

28. Do you have access to a garden that grows foods and/or herbs?

- ☐ No
- ☐ Yes
- ☐ Don't know

### **Section Header**

29. How confident do you feel about being able to cook raw or basic ingredients?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

30. Preparing foods using methods like cooking, chopping, mixing and stirring?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

31. How confident do you feel about using different methods to cook foods such as boiling, stir-frying, steaming and grilling?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

32. How confident do you feel about using different methods for cooking; for example, stove top, oven, microwave, and barbeque?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

33. How confident do you feel in your ability to read recipes?

- ☐ Not confident at all

- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

34. How confident do you feel about following a simple recipe?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

35. How confident do you feel in your ability to cook grains, for example, rice, pasta, couscous?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

36. How confident do you feel in your ability to cook vegetables?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

37. How confident do you feel in your ability to cook meat including fish and/or poultry?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

38. How confident do you feel in your ability to prepare a well-balanced meal? A well balanced meal would provide half a plate of vegetables, a quarter plate of meat or meat alternative, and a quarter plate of grain products like pasta or rice.

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident



39. How confident do you feel in your ability to read the Nutrition Facts label to make healthy choices? For example, low fat, low salt, low calorie, high fiber?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

40. How confident do you feel in your ability to change recipes to make them healthier? For example, lower sugar, lower fat, lower sodium, and higher fiber?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

41. How confident do you feel in your ability to handle, store, and prepare foods safely?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

42. How confident do you feel about preparing and cooking new foods and recipes?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

43. How confident do you feel about tasting foods that you have not eaten before?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

44. How confident do you feel in your ability to use substitutions in a recipe if you don't have a specific ingredient?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

45. How confident do you feel in your ability to use leftovers to prepare new meals?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

46. How confident do you feel in your ability to know when your food is cooked?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

47. How confident do you feel in your ability to plan meals for the week?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident
- ☐ Extremely confident

48. How confident do you feel about purchasing foods?

- ☐ Not confident at all
- ☐ Not confident
- ☐ Neither not confident nor confident
- ☐ Confident

- Extremely confident

49. How confident do you feel about purchasing new foods?

- Not confident at all
- Not confident
- Neither not confident nor confident
- Confident
- Extremely confident

50. How confident do you feel in your ability to compare food prices to save money?

- Not confident at all
- Not confident
- Neither not confident nor confident
- Confident
- Extremely confident

### Section Header

51. Do you know how many portions of fruit and vegetables do you think health experts recommend eating every day?

- 0
- 1
- 2
- 3
- 4
- 5 or more

52. The temperature danger zone is \_\_\_\_F to \_\_\_\_F

53. Name three dry-heat cooking methods

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

54. Name three moist-heat cooking methods

- \_\_\_\_\_
- \_\_\_\_\_
- \_\_\_\_\_

55. I can chop an onion into a medium dice.

- ☐ No
- ☐ Yes
- ☐ I don't know

56. I can mince garlic.

- ☐ No
- ☐ Yes
- ☐ I don't know

57. I can Julienne carrots.

- ☐ No
- ☐ Yes
- ☐ I don't know

58. I can zest a lemon.

- ☐ No
- ☐ Yes
- ☐ I don't know

59. I can blanch vegetables.

- ☐ No
- ☐ Yes
- ☐ I don't know

60. I can cook chicken to the proper internal temperature.

- ☐ No
- ☐ Yes
- ☐ I don't know

61. I can use the correct measuring tool to measure water.

- ☐ No
- ☐ Yes
- ☐ I don't know

62. I can use the correct measuring tool to measure flour.

- ☐ No
- ☐ Yes
- ☐ I don't know

63. I can properly store foods to avoid cross-contamination.



- ☐ No
- ☐ Yes
- ☐ I don't know

### **Section Header-Food insecurity**

64. Do you ever worry that you do not have enough money to buy the quality of foods you wish to buy?
- ☐ No
  - ☐ Yes
  - ☐ I don't know
65. In the past month, did you ever cut the size of your meals or skip meals because there wasn't enough money for food?
- ☐ No
  - ☐ Yes
  - ☐ Don't know
66. In the past month, did you ever eat less than you felt you should because there wasn't enough money for food?
- ☐ No
  - ☐ Yes
  - ☐ Don't know
67. If you answered "Yes" to any of the following questions, check all that apply.
- ☐ I did not have enough money to buy enough food
  - ☐ I do not know how to purchase food
  - ☐ I do not know how to prepare or cook food
  - ☐ Other \_\_\_\_\_

**You are almost finished. This is the last set of questions. Make sure you complete the survey to receive 10 extra credit points**

### **Demographic Questions**

**You are almost finished. This is the last set of questions. Make sure you complete the survey.**

68. What is your age? \_\_\_\_\_

69. Are you?  
☐ Male ☐ Female
70. Are you?  
☐ Married ☐ Single
71. Are you Hispanic or Latino?  
☐ Yes ☐ No
72. What is your race? (Check all that apply)  
☐ White/Caucasian  
☐ Black/African American  
☐ American Indian or Alaska Native  
☐ Native Hawaiian or Other Pacific Islander  
☐ Asian  
☐ Other (please specify): \_\_\_\_\_
73. Do you live?  
☐ On-campus  
☐ Off-campus
74. Choose the option that best describes your current living situation?  
☐ Single dorm  
☐ Dorm with roommates  
☐ Single apartment  
☐ Apartment with roommates  
☐ Commuter
75. Including yourself, how many adults (over 19 years old) live with you?  
\_\_\_\_\_ Adults  
  
\_\_\_\_\_ Children (18 years or younger)
76. How many people do you usually prepare food for on a day to day basis?  
☐ 1  
☐ 2  
☐ 3  
☐ 4  
☐ 5 or more

77. What is your current academic standing?

- ☐ Freshman
- ☐ Sophomore
- ☐ Junior
- ☐ Senior

78. What is your major? \_\_\_\_\_

79. Are you currently employed?

- ☐ No
- ☐ Yes, part-time
- ☐ Yes, full-time

80. What is your income?

- ☐ Less than \$15,000 per year
- ☐ \$15,001 to \$25,000 per year
- ☐ \$25,001 to \$50,000 per year
- ☐ \$50,001 to \$75,000 per year
- ☐ \$75,001 or More per year

81. What are the last 6-digits of your cell phone number? (Ex: 828-262-2233 would be 622233) \_\_\_\_\_

82. Thank you for time. To receive 10 extra credit point, please email a screenshot of your completed survey to Sakina Crain ([crainesf@appstate.edu](mailto:crainesf@appstate.edu))

83. Want 10 more extra credit points? You will get another email in a few months with a link to a new survey. Be sure to complete the last survey. The next survey will be shorter than the one you just completed.

84. If you have any questions, please email Sakina Craine ([crainesf@appstate.edu](mailto:crainesf@appstate.edu)) or Maggie Morgan ([morganml4@appstate.edu](mailto:morganml4@appstate.edu)).

### **Question for Pilot Run**

How many minutes did it take you to complete this survey?

**Opinions about the Course (at pre)**

Why did you choose to take Basic Food Science/Basic Food Science Lab?

What skills are you most interested in learning in the Basic Food Science Lab?

**Opinions about the Course (at post)**

85. Did you learn the skills you wanted to learn in the Basic Food Science Lab?

86. How do you feel overall about the lab?

87. What things did you dislike about the course?

88. Is there anything you feel should be improved if the course is run again?

89. Do you have any other valuable feedback you would like to provide?

## **Appendix F: USDA Abstract and Poster**

### **Improving Food Security and Food Literacy Among Students Enrolled in a Basic Food Science Lab at Appalachian State University**

Maggie Morgan, BS; Jamie Griffin, PhD, RDN, LDN

#### **Abstract:**

Food insecurity among college students is gaining national attention. This disparity in college students may be attributed to limited food literacy, availability and ability to purchase and prepare healthful foods, along with ease and availability of processed or fast food.

A dual relationship between food insecurity and inadequate food literacy exists. According to recent reports, between 46.2%-62% of Appalachian State University (ASU) students experience some aspect of food insecurity. College learning experiences can help increase food literacy.

Courses that increase food literacy hold potential to reduce food insecurity. The Basic Food Science Lab (Basic Foods Lab) at ASU is well poised to act as a catalyst to increase these skills to reduce student food insecurity. Pilot data collected during Fall 2018 identified the following barriers in students (n=58): 31% decreased the size or skipped a meal and ate less food within the past month due to lack of financial resources to acquire food, and 91% stated money was a big influence on food purchase choices.

With these barriers identified, the ASU Basic Foods Lab will conduct a research project during Spring 2019. The goal of the project is to increase food literacy and combat food insecurity through a structured food literacy-based curriculum. Objective and outcomes will be measured at post-term along with specific measures that identify each student's food security level. Results of this study are forthcoming in Fall 2019.

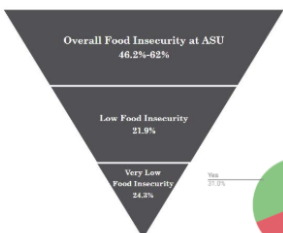
# Improving Food Security and Food Literacy Among Students Enrolled in a Basic Food Science Lab at Appalachian State University

Beaver College of Health Sciences  
APPALACHIAN STATE UNIVERSITY

Maggie Morgan, BS; Jamie Griffin, PhD, RDN, LDN

## Food Literacy and Food Insecurity Prevalence<sup>1-5</sup>

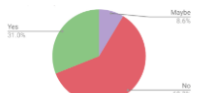
Food insecurity among college students may be attributed to limited food literacy; the inability to purchase and prepare healthful foods, along with the ease and availability of processed or fast food. A dual relationship exists between food insecurity and inadequate food literacy. College learning experiences can help increase food literacy.



In the past month, did you ever cut the size of your meals or skip meals because there wasn't enough money for food?\*



In the past month, did you ever eat less than you felt you should because there wasn't enough money for food?\*



\*Data from Fall 2018 pilot study

## Barriers to Food Literacy and Food Security\*

There has been a time when I did not have enough money to buy food.

I need to learn how to budget better when it comes to buying food.

I have issues with money management and it affects how I eat.

I have a seasonal job... some months are harder than others to purchase groceries.

91% stated money is a big influence on food purchase choices.

Food Literacy and Food Insecurity Prevalence

Barriers to Food Literacy and Food Security

Basic Foods Lab

Next Steps

## Basic Foods Lab

Lab objectives revolve specifically around improving food literacy and food security. Students will:

- Properly demonstrate sanitizing lab stations and cooking space as well as making a sanitizing solution.
- Enhance their ability to eliminate food waste from purchased items.
- Properly cook each food item to its appropriate internal cooking temperature and demonstrate checking for doneness using a food thermometer.
- Prepare food within a limited budget.
- Cost out recipes.



## Next Steps

In Spring 2019, students (n=58) in the Basic Food Science Lab were invited to participate in a research project to increase food literacy and to combat food insecurity through a structured food literacy-based curriculum. Students (n=59) provided consent and completed the pre-assessment. Post-assessment data will be collected after the final lab week.

### Timeline of Project:

- Before classes began on January 13th, the Recruitment Script was emailed to all lab sections through AsULearn. The pre-assessment survey link was available from January 7, 2019 to noon on January 22, 2019.
- The last day of lab is April 25th. The post-assessment survey link will be available from 8:00 pm on April 25, 2019 to 11:55 pm on May 5, 2019.

Results of this study are forthcoming in Fall 2019.

### References

1. Haines TS, Miller M, Clark S, Morrison RM. College students identify university support for basic needs and food skills as key ingredients in addressing food insecurity on campus. *Food Insecurity in a post-recession era: the role of food literacy and food security*. Child Abuse Negl. 2017;73(10):158-166. Accessed September 6, 2019.
2. Griffin J, Griffin J, Griffin J, Griffin J. Examining the Association Between Food Literacy and Food Insecurity. *Research*. 2019;12(1):1-10. doi:10.1002/fores.10010.
3. Davis A, Smith M, Grady C. Report on Food Insecurity and Food Literacy Among Appalachian State University Students During the 2017-2018 Academic Year. Appalachian State University website. <https://www.appstate.edu/food-literacy-and-food-security-research/>. Accessed February 26, 2019.
4. Alvarado L, Hall S, Black A, Nelson. High prevalence of Food Insecurity Among University Students in Appalachia: Barriers to Food Literacy Interventions and Policy Advocacy. *PLoS ONE*. 2018;13(10):e0201070.
5. Alvarado L, Rosencrans R, Worthington K. Winter: Food Insecurity at a University in Appalachia: Experiences. *Higher Education: Theoretical Research in Higher Education*. J University Health. 2018;13(10):1070.

## Appendix G: FNCE Abstract and Poster

### *Improving Food Security and Food Literacy Among Students Enrolled in a Basic Food Science Lab at Appalachian State University*

*Maggie Morgan, BS; Jamie Griffin, PhD, RDN, LDN*

#### Learning Need Code

- 4070 Food security and hunger

#### Learning Objective-Poster

1. After the presentation, the participant will be able to describe the impact of a food literacy-based curriculum on food security and food preparation skills among students attending an Appalachian university.

#### Track

Wellness and Public Health

Education, Training, and Counseling

#### Abstract

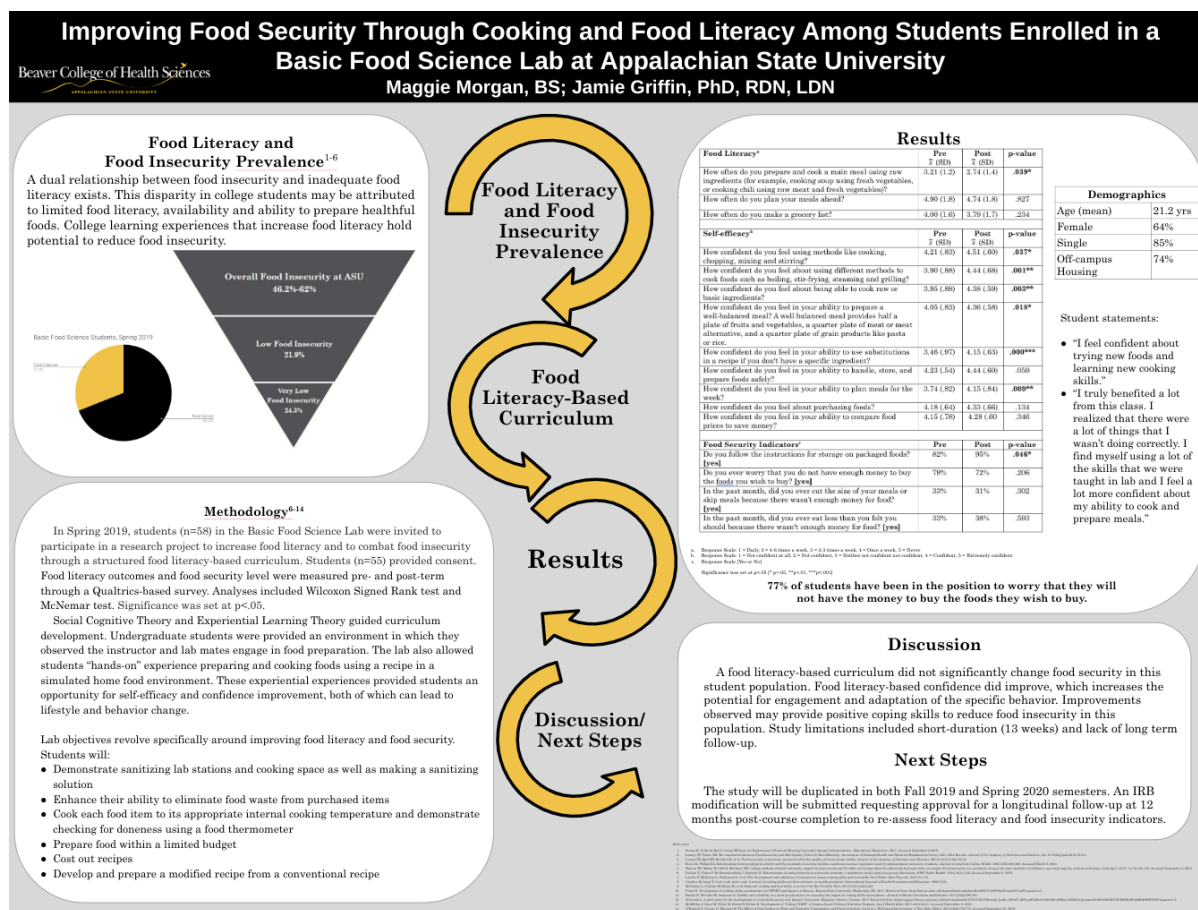
A dual relationship between food insecurity and inadequate food literacy exists. This disparity in college students may be attributed to limited food literacy, availability and ability to prepare healthful foods. College learning experiences that increase food literacy hold potential to reduce food insecurity.

During Spring 2019, the Basic Food Science Lab conducted a research project to increase food literacy and combat food insecurity through a structured food literacy-based curriculum. Food literacy outcomes and food security level were measured pre- and post-term through a Qualtrics-based survey. Analyses included Wilcoxon Signed Rank test and McNemar test.

Students (n=39) were single (85%), female (64%), with a mean age of 21. 2 years. Over 30% identified as food insecure. Results showed an increase in food literacy-based confidence ( $p < .05$ ) in Food Label reading, meal planning, preparing a well-balanced meal, and cooking with raw or basic ingredients; and ability to make recipe substitutions ( $p < .001$ ). Food security did not improve ( $p = .344$ ); however, a trend was observed. From pre- to post-term, food security indicators such as ability to prepare/cook foods, cutting size of a meal or meal skipping, and worry about lack of money to buy food improved.

A food literacy-based curriculum did not significantly change food security status in this student population; food literacy-based confidence did improve. Increasing confidence in a behavior increases the potential for engagement and adaptation of the specific behavior. Food literacy

improvements observed may provide positive coping skills to help reduce food insecurity in this target student population.





## **Appendix H: NCAND Abstract and Poster**

### ***Improving Food Security and Food Literacy Among Students Enrolled in a Basic Food Science Lab at Appalachian State University***

***Maggie Morgan, BS; Jamie Griffin, PhD, RDN, LDN***

A dual relationship between food insecurity and inadequate food literacy exists. This disparity in college students may be attributed to limited food literacy, availability and ability to prepare healthful foods. College learning experiences that increase food literacy hold potential to reduce food insecurity.

During Spring 2019, the Basic Food Science Lab conducted a research project to increase food literacy and combat food insecurity through a structured food literacy-based curriculum. Food literacy outcomes and food security level were measured pre- and post-term through a Qualtrics-based survey. Analyses included Wilcoxon Signed Rank test and McNemar test.

Students (n=39) were single (85%), female (64%), with a mean age of 21. 2 years. Over 30% identified as food insecure. Results showed an increase in food literacy-based confidence ( $p < .05$ ) in Food Label reading, meal planning, preparing a well-balanced meal, and cooking with raw or basic ingredients; and ability to make recipe substitutions ( $p < .001$ ). Food security did not improve ( $p = .344$ ); however, a trend was observed. From pre- to post-term, food security indicators such as ability to prepare/cook foods, cutting size of a meal or meal skipping, and worry about lack of money to buy food improved.

A food literacy-based curriculum did not significantly change food security status in this student population; food literacy-based confidence did improve. Increasing confidence in a behavior increases the potential for engagement and adaptation of the specific behavior. Food literacy improvements observed may provide positive coping skills to help reduce food insecurity in this target student population.

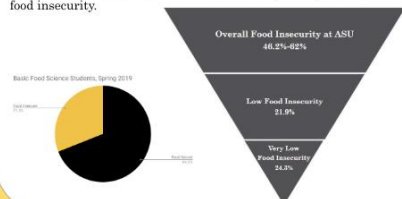
# Improving Food Security Through Cooking and Food Literacy Among Students Enrolled in a Basic Food Science Lab at Appalachian State University

Beaver College of Health Sciences  
APPALACHIAN STATE UNIVERSITY

Maggie Morgan, BS; John Arrowood, MS, RD, LDN; Alisha Farris, PhD, RDN; Jamie Griffin, PhD, RDN, LDN

## Food Literacy and Food Insecurity Prevalence<sup>1-6</sup>

A dual relationship between food insecurity and inadequate food literacy exists. This disparity in college students may be attributed to limited food literacy, availability and ability to prepare healthful foods. College learning experiences that increase food literacy hold potential to reduce food insecurity.



## Methodology<sup>6-14</sup>

In Spring 2019, students (n=58) in the Basic Food Science Lab were invited to participate in a research project to increase food literacy and to combat food insecurity through a structured food literacy-based curriculum. Students (n=55) provided consent. Food literacy outcomes and food security level were measured pre- and post-term through a Qualtrics-based survey created from a previously validated tool. Analyses included Wilcoxon Signed Rank test and McNemar test. Significance was set at  $p < .05$ .

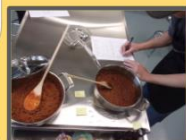
Social Cognitive Theory and Experiential Learning Theory guided curriculum development. Undergraduate students were provided an environment in which they observed the instructor and lab mates engage in food preparation. The lab also allowed students "hands-on" experience preparing and cooking foods using a recipe in a simulated home food environment. These experiential experiences provided students an opportunity for self-efficacy/confidence improvement, which can lead to lifestyle and behavior change.

Lab objectives revolve specifically around improving food literacy and food security. Students will:

- Demonstrate sanitizing lab stations and cooking space as well as making a sanitizing solution
- Enhance their ability to eliminate food waste from purchased items
- Cook each food item to its appropriate internal cooking temperature and demonstrate checking for doneness using a food thermometer
- Prepare food within a limited budget
- Cost out recipes
- Develop and prepare a modified recipe from a conventional recipe



Knife Skills



Recipe Preparation



Recipe Modification

## Results

Food Literacy <sup>a</sup>	Pre T (SD)	Post T (SD)	p-value
How often do you prepare and cook a main meal using raw ingredients (for example, cooking soup using fresh vegetables, or cooking chili using raw meat and fresh vegetables)?	3.21 (1.2)	2.74 (1.4)	.039*
How often do you plan your meals ahead?	4.90 (1.8)	4.74 (1.8)	.827
How often do you make a grocery list?	4.90 (1.6)	3.79 (1.7)	.024
Self-efficacy <sup>b</sup>	Pre T (SD)	Post T (SD)	p-value
How confident do you feel using methods like cooking, chopping, mixing and stirring?	4.21 (8.0)	4.51 (8.0)	.037*
How confident do you feel about using different methods to cook foods such as boiling, air-frying, steaming and grilling?	3.90 (8.0)	4.44 (8.0)	.001**
How confident do you feel about being able to cook raw or basic ingredients?	3.95 (8.0)	4.38 (8.0)	.003**
How confident do you feel in your ability to prepare a well-balanced meal? A well-balanced meal provides half a plate of fruits and vegetables, a quarter plate of meat or meat alternative, and a quarter plate of grain products like pasta or rice.	4.05 (8.0)	4.36 (8.0)	.018*
How confident do you feel in your ability to use substitutions in a recipe if you don't have a specific ingredient?	3.46 (9.7)	4.15 (8.0)	.000***
How confident do you feel in your ability to handle, store, and prepare foods safely?	4.23 (3.4)	4.44 (8.0)	.000
How confident do you feel in your ability to plan meals for the week?	3.74 (8.0)	4.15 (8.0)	.009**
How confident do you feel about purchasing foods?	4.18 (8.4)	4.53 (8.0)	.134
How confident do you feel in your ability to compare food prices to save money?	4.13 (1.70)	4.28 (4.0)	.346
Food Security Indicators <sup>c</sup>	Pre	Post	p-value
Do you follow the instructions for storage on packaged foods?	82%	95%	.046*
Do you ever worry that you do not have enough money to buy the foods you wish to buy? [yes]	79%	72%	.206
In the past month, did you ever cut the size of your meals or skip meals because there wasn't enough money for food? [yes]	33%	31%	.302
In the past month, did you ever eat less than you felt you should because there wasn't enough money for food? [yes]	33%	38%	.583

<sup>a</sup> Response Scale: 1 = Daily, 2 = 4-6 times a week, 3 = 2-3 times a week, 4 = Once a week, 5 = Never.  
<sup>b</sup> Response Scale: 1 = Not confident at all, 2 = Somewhat, 3 = Confident, 4 = Very confident, 5 = Extremely confident.  
<sup>c</sup> Response Scale: Yes or No.

Significance was set at  $p < .05$ . \* $p < .05$ , \*\* $p < .01$ , \*\*\* $p < .001$ .

77% of students have been in the position to worry that they will not have the money to buy the foods they wish to buy.

Demographics	
Age (mean)	21.2 yrs
Female	64%
Single	85%
Off-campus Housing	74%

## Student statements:

- "I feel confident about trying new foods and learning new cooking skills."
- "I truly benefited a lot from this class. I realized that there were a lot of things that I wasn't doing correctly. I find myself using a lot of the skills that we were taught in lab and I feel a lot more confident about my ability to cook and prepare meals."

## Discussion

A food literacy-based curriculum did not significantly change food security in this student population. Food literacy-based confidence did improve, which increases the potential for engagement and adaptation of the specific behavior. Improvements observed may provide positive coping skills to reduce food insecurity in this population. Study limitations included short-duration (13 weeks) and lack of long term follow-up.

## Next Steps

The study will be duplicated in both Fall 2019 and Spring 2020 semesters. An IRB modification will be submitted requesting approval for a longitudinal follow-up at 12 months post-course completion to re-assess food literacy and food insecurity indicators.

Beaver College of Health Sciences, Appalachian State University, 1000 University Blvd., Boone, NC 28608. Phone: 828/261-6000. Fax: 828/261-6001. Email: beaver@appstate.edu. Website: www.beavercollege.org. This document is for informational purposes only and does not constitute a contract. The information contained herein is for informational purposes only and does not constitute a contract. The information contained herein is for informational purposes only and does not constitute a contract.

### **Vita**

Maggie Morgan is a native of Boyertown, Pennsylvania. She is the daughter of Frank and Mindy Morgan. She graduated from Boyertown Area Senior High School in 2014. Maggie continued her education at The Pennsylvania State University, where she earned a Bachelor of Science in Nutrition and Dietetics. She received her Master of Science in Nutrition and Dietetics from Appalachian State University in May 2020. Maggie will pursue a career as a Registered Dietitian Nutritionist.